

THE SKY ABOVE US



THE BASIC SCIENCE EDUCATION SERIES

1

THE SKY ABOVE US

BICKLER SCHOOL

By

BERTHA MORRIS PARKER
LABORATORY SCHOOLS, UNIVERSITY OF CHICAGO

Checked for Scientific Accuracy by
G. VAN BIESBROECK
Yerkes Observatory



Intermediate

AUSTIN PUBLIC SCHOOL

COPYRIGHT, 1941 **ROW, PETERSON AND COMPANY** PRINTED IN U.S.A.

NEW YORK CITY EVANSTON, ILLINOIS SAN FRANCISCO

ALL RIGHTS RESERVED IN ALL COUNTRIES

The Sky Above Us

The Sky Itself

THE *sky* looks like a big bowl turned upside down, but it is not like a bowl at all. It is not solid like the china or glass of a bowl. No matter how high above the earth you went, you could not bump your head on the sky.

The blue sky we often see in the daytime is nothing but sunlit air. Sunlight is made up of all the colors of the rainbow. Blue is one of them. The air high above the earth catches the sunlight and scatters it in all directions. As we look up at the sky, more blue light comes to our eyes than any other color.

If you could go up so high above the earth that you were above all the air, the sky would not look blue. It would look black instead. You would see the sun and some stars and perhaps the moon, but in between them you would be looking up into empty space. There would be nothing to scatter the sunlight over the sky.

At night, after the sun has set, the sky does not look very blue to most people, but it does not look black if the night is clear. The air scatters moonlight and starlight just as it does sunlight. But moonlight and starlight are not so bright as sunlight.

In the daytime the sky is not always blue. Clouds sometimes shut out much of the sunlight and make the sky gray or white instead of blue. Small clouds may make patches of gray or white in a blue sky. On a cloudy night the sky may look black.

For hundreds and hundreds of years people have studied the sky. They have watched the sun and moon and stars seem to march across it. They have done a great deal of wondering about what they saw. This book will tell you a little of what they have found out.

The Sun

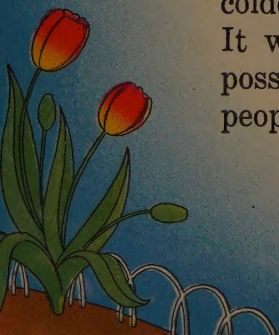
If you were drawing a circle to show how big the *sun* looks to you, how big would you make the circle? Probably you would make your circle about the size of a dinner plate.

The sun is really very, very, very large. It is much larger than the earth. The sun is so large that, if it were hollow, there would be room inside it for more than a million earths. The sun looks small because it is far away from us. The sun is about 93 million miles away.

There is no way at all of traveling to the sun. But suppose you could travel to the sun in an airplane. If you were to go to the sun in the fastest airplane that has ever been built, and if the airplane traveled on and on without stopping, you would get to the sun in about twenty years.

But you would not want to visit the sun if you could. The sun is very, very hot. It is hotter than any furnace you have ever seen. The light of the sun would blind you if you were to get close to the sun.

Try to imagine what the earth would be like if there were no sun. It would always be as dark as it is now on a moonless night. And it would be far, far colder than it is now on the coldest day of the winter. It would be so dark and so cold that we could not possibly live here. Is it any wonder that some of the people of long ago worshiped the sun?



You may have heard
someone call the sun a star.
It is a star. It looks larger than
any other star because it is
much nearer than any other star.
The sun is very far away, but the
other stars are much, much, much
farther away than the sun.

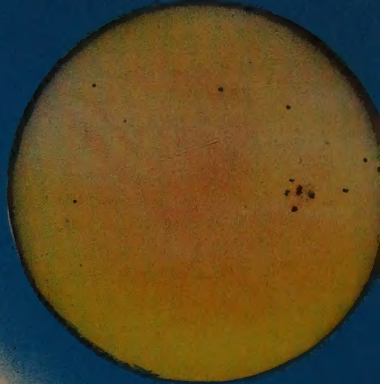
The picture of the sun on this page shows
some dark spots on the sun. These spots are called
sunspots. Sunspots are great storms on the sun.

You should not try to look at the sun when it is
high in the sky. The sun is so bright when it is high
in the sky that looking at it may hurt your eyes badly.
Probably you know that many people use telescopes
to study the sky. A telescope is an instrument for
seeing things that are far away. Looking at the sun
through a telescope of any kind when the sun is high
in the sky is even more dangerous than looking at
it with your eyes alone.

Years and Days

The *earth* travels around the sun. It travels in a
path that is almost a circle. It takes the earth a whole
year to travel around the sun once. The earth travels
fast, but its path is very long.

The year is divided into four *seasons*—*spring*,
summer, *autumn*, and *winter*. If the earth did not
travel around the sun, we would not have any change
of season. Now we have winter when the earth is
traveling over one part of its path, and we have
spring, summer, and autumn when it is traveling
over other parts of its path (page 6).





Suppose the earth should stop traveling around the sun today and should stay in the place in which it is now. Then we would keep on having all the time the season we are having now.

As you perhaps know, when the northern half of the earth is having winter, the southern half of the earth is having summer. In the same way, when the northern half of the earth is having summer, the southern half of the earth is having winter. If the earth should stand still in the place it is on New Year's Day, the northern half of the earth would keep on having winter, and the southern half of the earth would never have any season but summer.

Of course, the earth will not stop moving around the sun. The seasons will keep on changing year after year after year.

Even if the earth did stop moving around the sun, it would not stay in the same place. It would fall to the sun. Perhaps you have heard of *gravity*. Gravity is the force, or pull, which holds us on the earth. It is the force which makes things fall down instead of up.

The sun pulls the earth just as the earth pulls the things that are on it. Suppose the earth should stop moving around the sun. Then the sun's gravity would pull the earth to the sun.

All the while the earth is traveling around the sun, it is spinning around like a top. The earth turns around once in a day.

If the earth did not spin around, the sun would not rise and set each day. It would not seem to move as it does across the sky. The sun seems to travel across the sky from the east to the west each day. It seems to only because the earth spins round from west to east.

The sun can shine on only half the earth at a time. Always one half of the earth is light, and one half is dark. It is always, then, *day* on one half of the earth and *night* on the other half. If the earth traveled around the sun without spinning around, every part of the earth would have day for half the year and night for half the year. As it is, most parts of the earth have daylight for part of each twenty-four hours and darkness for part of each twenty-four hours.

It would be easier to explain about day and night if the word "day" did not mean two different things. It means twenty-four hours. It also means the part of the twenty-four hours between sunrise and sunset. When we talk about having long days in summer and short days in winter, we mean that it is longer between sunrise and sunset in the summer than in the winter.

We have daylight for more than half of each twenty-four hours during the spring and summer months and for less than half of each twenty-four hours during the autumn and winter months.





We should be very glad that the earth does spin around. It would not be pleasant to have daylight for six months and darkness for six months.

The Moon

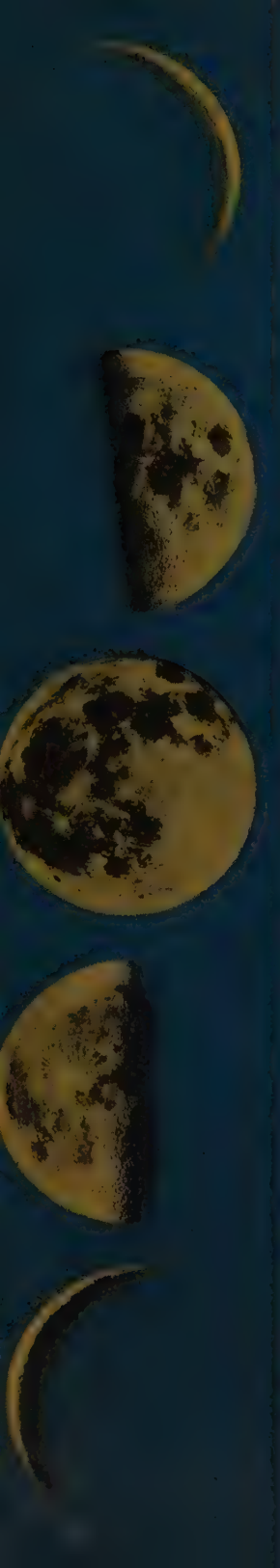
When you were trying to imagine what the earth would be like without a sun, you may have said, "We would have the *moon*, and it would give us some light and some heat." We would have the moon, but it would not give us any light or any heat. The moon is not hot like the sun. It does not send out any light of its own. We could never see the moon if the sun did not shine on it. Moonlight is really sunlight that has traveled first to the moon and then to the earth.

The moon when it is full looks the same size as the sun, but the moon is really not nearly so large as the sun. The moon is much smaller than the earth. It looks as large as the sun because it is not nearly so far away as the sun. It is the earth's nearest neighbor.

There is no way of traveling to the moon. But if the fastest airplane ever invented *could* travel to the moon, it would reach the moon in about twenty days.

The moon rises and sets just as the sun does. The daily rising and setting of the moon, like the rising and setting of the sun, are caused by the spinning of the earth.

You usually think of the moon as a part of the night sky. But often the moon can be seen in the daytime. When you see the moon in the sky during the day, it is very pale. It is pale because the sun is very much brighter. A candle flame looks bright if it is the only light in a room at night. But if there are bright electric lights in the room, the candle flame looks pale. The moon is like the candle flame.



Why the Moon Hides Its Face

The moon, as of course you know, seems to change its shape. Sometimes it looks big and round like a dinner plate. Sometimes it is only a narrow *crescent*. If you were to watch it night after night, it would seem to grow from a tiny crescent to a *full moon*. Then it would seem to shrink till there was no moon at all.

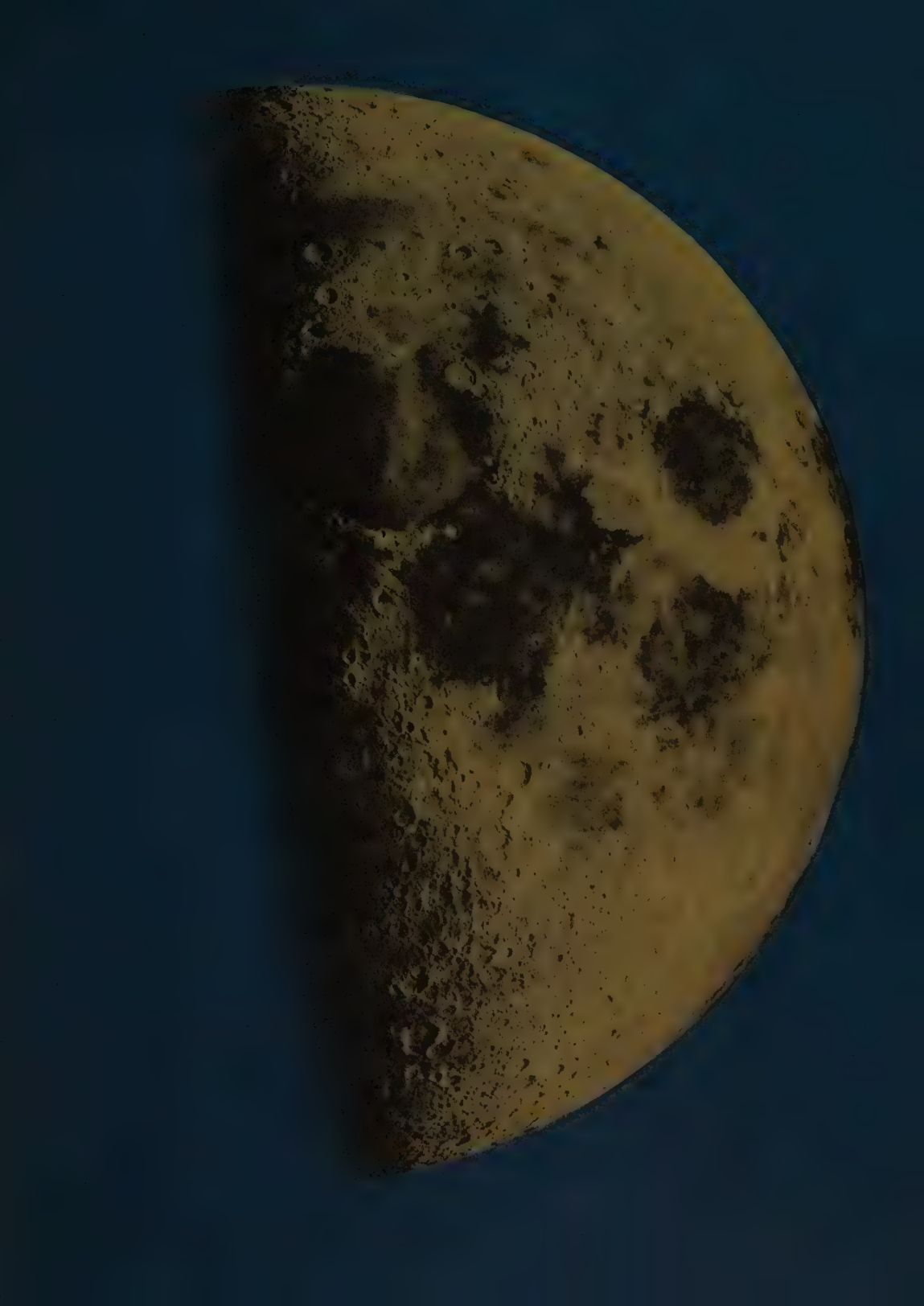
The moon does not really change its shape. It is always a big round ball. It seems to change its shape because it travels around the earth.

The moon, as you have already been told, does not give off any light of its own. It is bright only because the sun is shining on it. The sun, however, can shine on only half the moon at one time. Half of the moon is always dark.

The moon always has the same side turned toward the earth. Let us call the side of the moon which is turned toward the earth the *face* of the moon.

When the earth and sun and moon are in this position, $\textcircled{E} \textcircled{M} \textcircled{S}$, the sun is not shining at all on the face of the moon. We do not see the moon at all.

When the moon has traveled a little way on its journey around the earth, the earth and sun and moon are no longer in line. They are in this position, $\textcircled{E} \textcircled{M} \textcircled{S}$. Then the sun is shining on a tiny part of the face of the moon. We see a narrow crescent.



As the moon travels farther around the earth, the sun shines on more and more of the face of the moon. At last the sun is shining on the whole face of the moon, and we see the round full moon. Then the sun shines on less and less of the moon's face, and the moon seems to be getting smaller. Finally, we cannot see the moon at all. Then the story of how the moon seems to change its shape begins all over again.

It is about a month from one full moon to the next one. It is about a month because it takes the moon about a month to travel around the earth.

The picture on page 8 is a picture of the full moon. The picture on page 11 shows the moon when the sun is shining on half of its face. Both of these pictures were taken through a telescope.

The Man in the Moon

Do you always try, when the moon is full, to see the *man in the moon*? Of course, there is not really a man in the moon. The dark spots that make the eyes and nose and mouth of the man in the moon are big flat places on the moon's surface. The moon has many mountains on it just as the earth has. The parts of the moon where there are mountains shine very brightly when the sun strikes them. The parts that are flat do not shine so brightly.

People used to think that the eyes and nose and mouth of the man in the moon were seas. They even gave names to the *seas*. Now we know that there are not any seas on the moon. There cannot be any seas on the surface of the moon because there is no water there. The seas are large flat plains. You can see some of the mountains and plains of the moon in the picture on the next page.



Part of Moon's Surface

*Courtesy of Yerkes Observatory
University of Chicago Press*

Some people see other pictures in the moon. Some see an old man carrying a bundle of sticks; others see a girl reading a book. Still other people see a hare jumping. All of these pictures are made by the mountains and the plains.

People have made up a great many stories about the pictures they see in the moon. Here is a story about the old man and his bundle of sticks.

A long time ago an old man went into the woods one Sunday to cut some wood for his fire. He cut some little sticks and tied them into a bundle. He hung the bundle of little sticks on a big strong stick. He then put the big stick over his shoulder and started home with his load. On his way home he met a stranger. The stranger was on his way to church.

The stranger stopped the old man and said, "Today is Sunday. You should not work on Sunday!"

"Sunday on earth or Monday in heaven, it's all the same to me," the old man said.

"Then you must carry your bundle forever," said the stranger. "You shall go to the moon and stay there forever to warn people not to work on Sunday."

The stranger vanished, and the old man found himself in the moon. He has had to stay there till this day for every one to see.

Of course, this story is not true. It is one of the stories people made up long ago to explain things they saw and could not understand.

The Stars

Stars are suns. Some of them are much bigger than our sun, and others are much smaller. They are all very, very far away. They look small because they are so far away.

If you were trying to draw a picture of a star, what shape would you make it? Would you draw it with five points? If you did, you would be wrong. A star does not have five points. It does not have any points at all. Stars are huge round balls.

People began drawing stars with points because stars twinkle. They twinkle because we are looking up at them through air. If we could go up above the air that surrounds the earth to look at the stars, they would not twinkle.

There are stars in all directions from the earth. We do not see any stars in the sky in the daytime because the sunlit air hides them. If we could go up above the air, we would see stars both day and night.

No one knows exactly how many stars there are. Some scientists think that there are as many stars as there are grains of sand on all the seashores in the



world. At least, there are so many that, if the number could be written here, it would be so large that you probably could not read it.

Most of the stars are so far away that you cannot see them unless you have a telescope. If you do not use a telescope, you never see more than two or three thousand stars at one time even on a very clear night.

Have you ever noticed the band of light that stretches across the sky from north to south on a clear night? We call this band of light the *Milky Way*. There is a picture of the Milky Way on page 2. Its light is starlight. It is light given off by many, many stars. Most of these stars are so far away that we cannot see them as separate stars. Perhaps the Milky Way, when you see it, will help you remember that there are millions and *millions* and MILLIONS and MILLIONS of stars besides our sun.

The "Picture-Book" of the Sky

Do you know the *Big Dipper* when you see it in the sky? The star map on this page shows you how it looks. You can see that there are seven bright stars in it.

These seven stars are a part of a large group of stars called "The Great Bear." There are many groups of stars in the sky. They are called *constellations*.

To the people of olden times, the sky was a great "picture-book." Each constellation was a picture of something they knew about. It is hard for us to see all the pictures the people of olden times saw in the sky.

It is easy for us to see the Big Dipper, but it is not easy for us to see that the Big Dipper makes part of a picture of a bear. The handle of the Dipper is the Great Bear's tail. The cup of the Dipper is a part of the Great Bear's body.

On most star maps the Great Bear is called *Ursa Major*. *Ursa Major* means "Great Bear." The words "Ursa Major" are Latin words. Latin is a language which was spoken long ago.

All the constellations have Latin names. On many star maps the Latin names are given.

Notice on the map of the Big Dipper the little star close to one of the stars in the handle of the Dipper. This star is *Alcor*. It is fun to try to find Alcor in the sky. Its name means "The Test." Only people with good eyes can see Alcor without a telescope.

The two stars that mark the outside edge of the Dipper are called "The Pointers." These two stars point to the *North Star*.

The North Star is very important. It is much more important to us than any other star except the sun. Since very early times people have told directions from this star.

The North Star is in the constellation of *Ursa Minor* ("The Little Bear" or "The Little Dipper"). It is the last star in the handle of the *Little Dipper* or the tail of the Little Bear. It is not a very bright



star. You can find it easily, however, if you let the two Pointers help you. Can you find the North Star in the picture on page 15?

Many of the stars of our sky rise and set just as the sun and the moon do. But the North Star does not rise or set. If you followed the North Star to the north, the star would be higher and higher in your sky until at last you reached the northernmost point on the earth—the point we call the *North Pole*. There the North Star would be almost exactly above you. Because the North Star is almost exactly above the North Pole, it stays in almost exactly the same place in the sky as the earth spins around.

In our part of the earth the stars that are near the North Star do not rise or set either. The turning of the earth makes them seem to move in the sky, but they do not disappear below the horizon. If you could see them both in the daytime and at night, they would seem to turn in a circle around the North Star. Of course, since the earth turns around once every day, the stars near the North Star seem to travel around the North Star once each day.

If you are in the northern half of the earth, the farther north you go, the more stars there are that do not rise or set.

If you live as far north as Chicago, both the Little Dipper and the Big Dipper are always above your horizon. They can be seen in the night sky on any clear night. *Cassiopeia* is another constellation which is so near the North Star that it does not rise or set. The bright stars of *Cassiopeia* make a big W in the sky. Sometimes the W is upside down. *Cassiopeia* and the Big Dipper are always on opposite sides of the North Star. As you can see from the map on page 17 *Cassiopeia* is supposed to be a woman sitting in a chair.

There are two constellations in the left-hand map on page 19. The people of long ago thought that the stars of the bigger constellation made the picture of a hunter. The straight row of three stars was his belt, and the row of stars going down from the belt was his sword. The brightest star in the whole constellation marked one knee, and the next brightest star one shoulder. A row of faint stars marked a lion skin held high. The stars of the other constellation made the picture of a big dog.

The Latin name for the Hunter is *Orion*. The Latin name for the Great Dog is *Canis Major*.

Orion is the brightest constellation in the sky, but you cannot see *Orion* every night. *Orion* is one of the constellations that rise and set, and it rises and sets at different times at different seasons of the year. *Orion* is a winter constellation for us. It shines brightly in the southern part of our sky on winter nights. We do not see *Orion* in the summer. Of course, if the sun were not so bright, we would see *Orion* in the sky in the daytime in summer.





Orion has two very bright stars in it, but the brightest star in the sky, not counting our sun, is a star in the Great Dog. The name of this very bright star is *Sirius*. It is often called "The Dog Star." If you find Orion in the sky, it will be easy to find Sirius. To find Sirius, look for a very bright star that is almost in line with the three stars of Orion's belt. Sirius is a bluish-white star.

Sirius is brighter than the other stars partly because it is not so far away as most stars are. But even Sirius is very, very far away. Light travels so fast that it can go as far as seven and a half times around the earth in one second. But it takes the light from Sirius between eight and nine years to reach us. If Sirius were to explode tonight, we would not see it explode for more than eight years.

The constellation in the right-hand map at the top of this page is an autumn constellation for us. It is *Pegasus* ("The Winged Horse"). Notice that four of the stars of this constellation form a square.

If you turn the map of Pegasus upside down, it is not hard to imagine that this constellation is a picture of the front part of a horse. The square is the front half of the horse's body. The other stars make the horse's head and its two front legs.

Large star maps will tell you the names of other stars and constellations. If you watch the sky often, you will probably come to know some of the stars and constellations very well. You will probably be able to call them by name as easily as you can call your friends by name.

The Story of the Two Bears

The people of olden times made up stories about the constellations just as they did about the man in the moon. There are many different stories about some of the constellations. This story of the Two Bears was told by the ancient Greeks, the people who lived in Greece long ago. Greece, you probably know, is a country in Europe.

Callisto was a beautiful maiden. She was so very beautiful that Juno, the queen of the gods, was angry.

Callisto had a little son whose name was Arcas. One day Callisto left Arcas with his nurse and went into the forest near her home to hunt. As she wandered about in the forest she met Juno.

She did not know who Juno was, but she said, "Good morning." Juno did not answer. She stood still and looked at Callisto.

Callisto stood still, too, and waited for Juno to move away. Callisto happened to look down at her own hands



and feet. Imagine her surprise when she saw that they were big paws. She had been changed to a bear!

For years Callisto wandered in the forest. In that time Arcas grew up to be a strong and handsome boy. He loved hunting just as his mother had loved it.

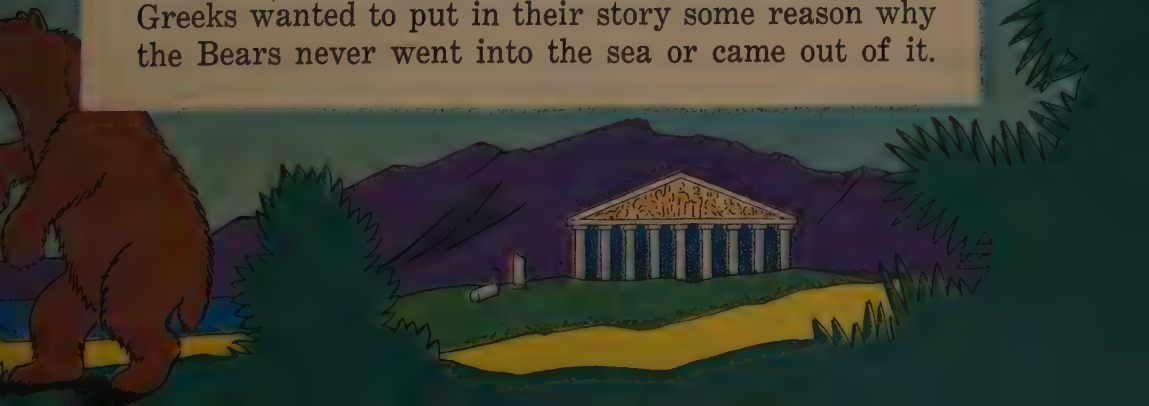
One day when Arcas was hunting in the forest, he saw a brown bear. The bear was Callisto, but of course Arcas did not know her. Callisto did know Arcas. When she saw him, she forgot that she was a bear and started toward him. He raised his spear and was about to drive it into his mother's throat. Jupiter, the king of the gods, saw what was happening.

Jupiter, however, could not change Callisto back into a woman. No god could undo what another god had done. But he could change Arcas into a bear, too. He did, just in time to save Callisto's life.

Jupiter knew that Juno would be angry when she found that he had saved Callisto's life. He knew that she might harm both Callisto and Arcas. To make them safe, he put both of them up in the sky.

When Juno saw them in the sky, she went to the god of the sea. She begged him never to let the Two Bears come into his kingdom. He promised, and ever since that time the Two Bears have wandered about in a circle in the sky.

To understand the last part of this story, you must know that Greece is almost surrounded by water. When the stars rose and set, the Greeks thought that they were coming out of and going into the sea. The Greeks wanted to put in their story some reason why the Bears never went into the sea or came out of it.



The Story of the Winged Horse

This story is another story told by the ancient Greeks. It is about Pegasus, the constellation in the right-hand map on page 19.

Long ago, in a faraway part of the earth, there lived a terrible monster. This monster had three heads. One was a lion's head, one was a goat's head, and one was a dragon's head. The monster breathed out smoke and flames. With its fiery breath, it killed every plant and animal it came near. Many brave men had tried to kill the monster, but all of them had failed.

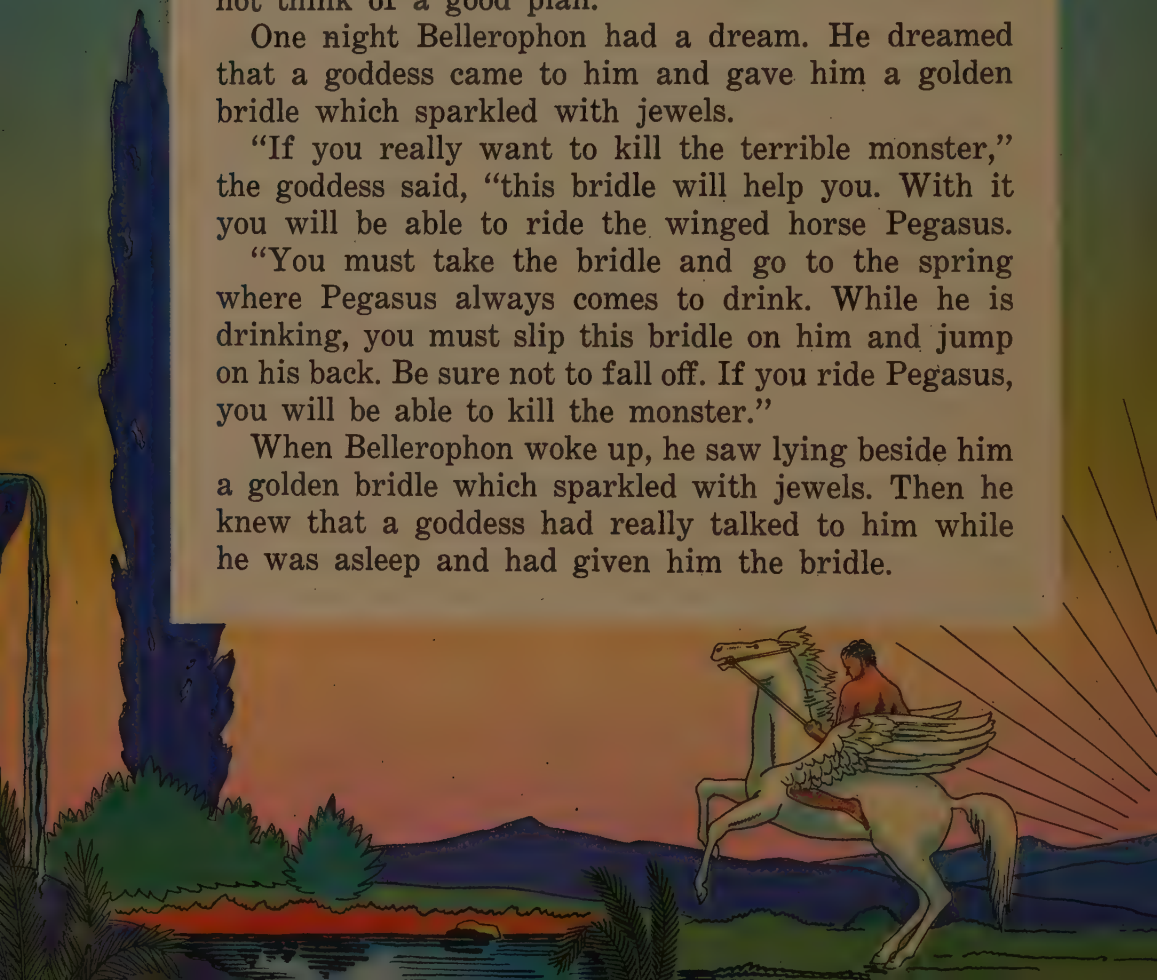
At last Bellerophon, a brave young Greek, decided that he would try to kill the monster. But he could not think of a good plan.

One night Bellerophon had a dream. He dreamed that a goddess came to him and gave him a golden bridle which sparkled with jewels.

"If you really want to kill the terrible monster," the goddess said, "this bridle will help you. With it you will be able to ride the winged horse Pegasus.

"You must take the bridle and go to the spring where Pegasus always comes to drink. While he is drinking, you must slip this bridle on him and jump on his back. Be sure not to fall off. If you ride Pegasus, you will be able to kill the monster."

When Bellerophon woke up, he saw lying beside him a golden bridle which sparkled with jewels. Then he knew that a goddess had really talked to him while he was asleep and had given him the bridle.



He set out at once to find Pegasus. He had no trouble finding the spring where Pegasus came to drink, but he had to wait many days before he caught Pegasus. Two or three times he saw the great white horse flying down from high in the air to the spring. But each time someone shouted and frightened Pegasus away.

At last, just as the sun rose one morning, Pegasus came to the spring. Bellerophon sprang forward and put the golden bridle on him. Then Bellerophon leaped up on the back of the great white horse.

Up Pegasus flew into the air. Never had Bellerophon ridden so fast. Pegasus turned and twisted and tried to throw Bellerophon off. But at last he saw that Bellerophon was his master, and he became very gentle.

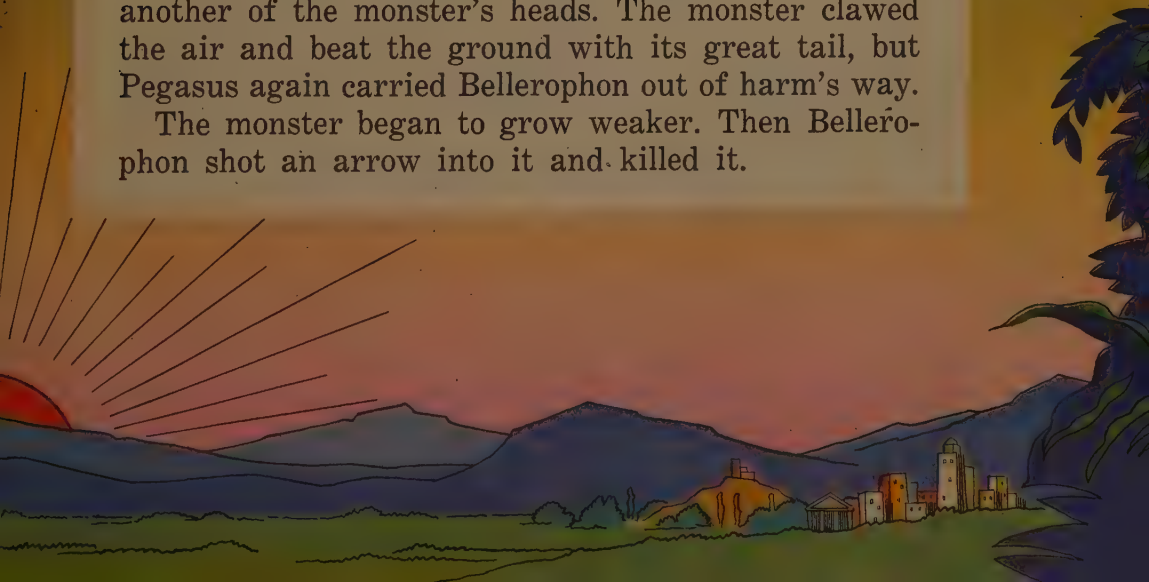
Bellerophon rode at once to the place where the great monster lived. The monster was in its cave when Bellerophon and Pegasus came near.

For a whole day Bellerophon and Pegasus waited. Then the monster came out of its cave with a great roar. It started down toward a village near by.

Pegasus flew toward the monster. Bellerophon, with his sharp sword, cut off one of the monster's heads. The monster sent great flames out of its mouths, but Pegasus flew away so fast that the flames did no harm.

Down again Pegasus flew. Bellerophon cut off another of the monster's heads. The monster clawed the air and beat the ground with its great tail, but Pegasus again carried Bellerophon out of harm's way.

The monster began to grow weaker. Then Bellerophon shot an arrow into it and killed it.



After the battle, Jupiter, the king of the gods, decided to put Pegasus in the sky. Bellerophon, he knew, was still needed on the earth. He sent a fly to sting the horse. When the fly stung him, Pegasus jumped so suddenly that Bellerophon fell off. Pegasus flew up to the sky, and there he has been ever since.

This story and the story of the Bears may seem very funny to you. But remember when you read them that these stories were made up by people who really wanted to understand about the world about them. The only way they knew of answering some of their own questions was to make up a story.

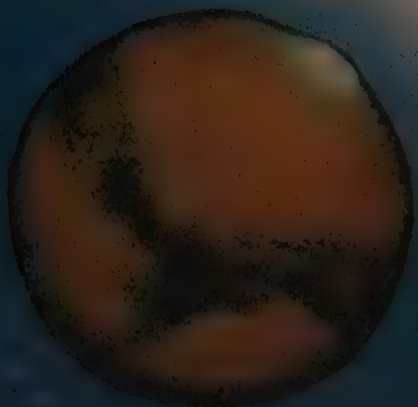
“Stars” That Are Not Stars

You may have heard people talk about evening stars and morning stars. You may have read in your newspapers sentences like these: “Venus is now the evening star.” “Jupiter is the morning star.” “Jupiter and Saturn are evening stars.” “Mars is an evening star this month.”

Venus, Mars, Jupiter, and *Saturn* look like bright stars when we see them in the sky, but they are really not stars at all. They are *planets* instead. The earth is a planet, too. Venus, Mars, Jupiter, and Saturn are, then, bodies somewhat like the earth. They all travel around the sun just as the earth does.

They do not give off any light of their own.

They shine because the sun is shining on them.



When a planet
is shining in our
sky just after sunset,
we call it an evening
star. When it is shining
in our sky just before
sunrise, we call it a
morning star.

Have you ever said
to yourself,

Starlight, starbright,
First star I see tonight!
I wish I may,
I wish I might,
Have the wish
I wish tonight.

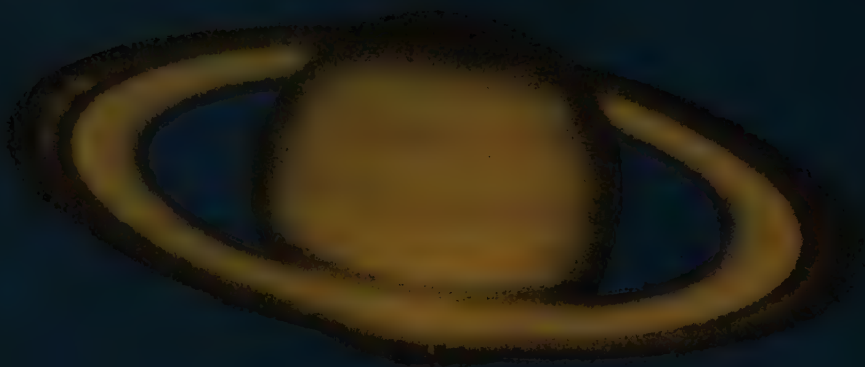
The "star" on which children wish is often Venus.
Venus can often be seen in the evening sky for many
minutes before any real stars are seen. It is much
brighter than any of the real stars.

But Venus cannot always be seen in the evening
sky. Sometimes it can be seen instead in the early
morning sky. It is, then, sometimes an evening star
and sometimes a morning star.

Jupiter, Mars, and Saturn are bright, but they are
never so bright as Venus at its brightest. All of them
may be either evening stars or morning stars.

The pictures on pages 24, 25, and 26 show you
Mars, Jupiter, and Saturn as they look through a big
telescope. Notice the bands of clouds across Jupiter,
and the white cap on Mars. Notice, too, the queer
rings around Saturn. The white cap on Mars may be





The Planet Saturn
Courtesy of Yerkes Observatory
University of Chicago Press

snow. No one is quite sure. The rings on Saturn are made up of tiny particles. Some of them are probably no larger than grains of dust. Saturn is sometimes called the most beautiful planet. Do you wonder?

The Sun's Family of Planets

You have been told the names of five of the sun's family of planets: the earth, Venus, Mars, Jupiter, and Saturn. Scientists know that the sun has four other big planets in its family—*Mercury*, *Uranus*, *Neptune*, and *Pluto*. It may have others that are so far away that no one has seen them. Mercury, Uranus, Neptune, and Pluto are not nearly so easy to see as Venus, Mars, Jupiter, and Saturn are. Neptune and Pluto can never be seen without a telescope. Uranus is very hard to see without a telescope. Mercury is so close to the sun that it is hard to see because of the glare of the sun. It is never high in the sky at night.

All the planets in the sun's family of planets are alike in some ways. They are all big and round. They all travel around the sun. They all have day and night. None of them gives off any light of its own.

The planets are not all alike in other ways. No two of those we know about are exactly the same size. Four of them we are sure are much bigger than the earth. Three of them we are sure are smaller than the earth. No one knows the exact size of Pluto. The planet Pluto is so far away from us that no one has yet been able to find out exactly how large it is.

Jupiter is the largest of the planets. In a picture of the sun's family you could make Jupiter any size you liked. In the picture on pages 28 and 29 it is two inches across. If you made Jupiter two inches across, you would have to make all the other planets less than two inches across. The picture on pages 28 and 29 shows you what size each one should be. Of course, the size of Pluto in the picture may not be right.





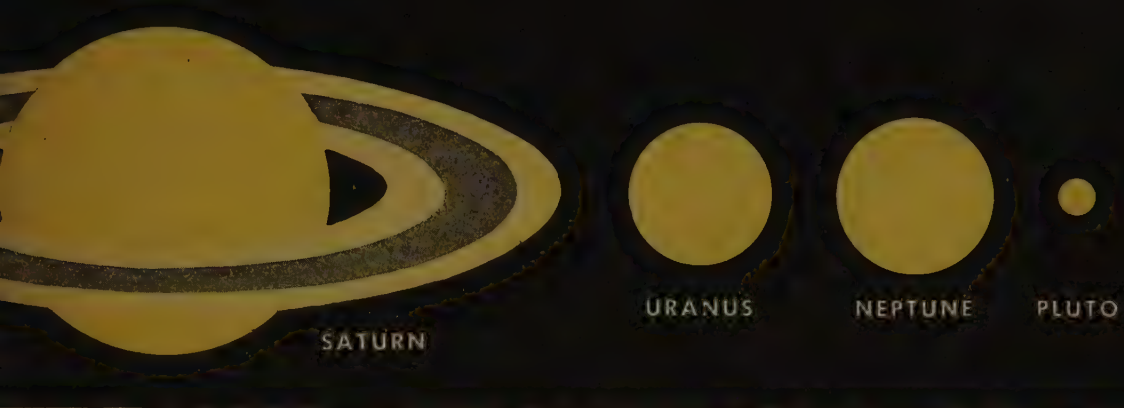
The planets are not all the same distance from the sun. Mercury is nearest the sun. Then, in order, come Venus, the earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto.

The earth has one moon. Some of the planets do not have any. Some have several moons. Jupiter has eleven moons.

We are sure that no people could live on Jupiter, Saturn, Uranus, Neptune, Pluto, and Mercury. We know Mercury is too hot. The others are too cold.

Mars is colder than the earth, but people might live in places on Mars if Mars had plenty of air and water. But Mars has very little air and water. If there are any people on Mars, they must be very, very different from the people on the earth.

Venus is sometimes called the earth's twin planet. It is about the same size as the earth (page 28). No one knows very much about Venus, because it is always covered with clouds. The clouds never break away. If they are clouds like ours, Venus must have plenty of water. But many scientists think that the clouds on Venus are made of dust instead of water. Venus is closer to the sun than we are, and of course it gets more heat from the sun than we do. Probably Venus is far too hot and too dry for people like us.



You may wonder why we do not look through a huge telescope and see whether there are any people of any kind on Mars and Venus. No telescope that has yet been made is strong enough to show people on Mars and Venus even if there are people there. Besides, the clouds which always cover Venus would keep us from seeing any people on Venus.

The earth, as you see, is not the biggest planet in the sun's family. But certainly it is the best planet for people to live on. Most scientists feel sure that it is the only planet that has people on it.

The sun also has in its family a great many very tiny planets. Sometimes these very tiny planets are called *planetoids*. There are more than a thousand of these tiny planets. New ones are being found year by year. These little planets are not at all important. They can never be seen with our eyes alone.

Comets

The picture on page 30 is the picture of a *comet*. Probably you have never seen a comet. There are hundreds and hundreds of comets, but most of them are not bright enough to be seen without a telescope. Even with a telescope, comets cannot be seen until they come within a few hundred million miles of the earth.



The word "comet" comes from an old Latin word that means "hair." If you look at the picture of the comet, you can guess why it has a name that means "hair." The comet, you see, has a tail. The tail of a comet made the people of long ago think of hair.

Comets do not always have tails. A comet does not have a tail until it comes close to the sun. When it is close to the sun, a comet may have more than one tail. A comet without a tail looks, through a telescope, like a fuzzy ball of light.

Of all the comets, Halley's comet is the most famous. When it visits the earth, it is bright enough to be seen without a telescope. Halley's comet is named for the scientist who first found out how often this comet visits us. It visits the earth every seventy-five years. Some comets do not visit us so often; some come much oftener.

Not very many years ago, the earth went through the tail of Halley's comet. Going through the tail of the comet did not hurt the earth at all. A comet's tail is made of gas. People would not have known that we were going

through the tail of a comet if scientists had not told them so.

Shooting Stars

If you were to watch the sky for an hour or two on a clear night, you would be very likely to see a *shooting star*. A shooting star looks like a real star which is shooting across the sky, but it is not a star at all.

A shooting star is really a tiny bit of material no bigger than a pea. It is falling toward the earth from somewhere out in space.

Sometimes shooting stars are called "falling stars." They have another name, too. Scientists call shooting stars *meteors*.

No one can see a meteor until it hits the air around the earth. A meteor is not a shooting star until it gets very, very hot as it pushes its way through our air. A shooting star is so hot that it burns up before it reaches the ground. Of course, the shooting star disappears when it is burned up. Any ashes that are left when a shooting star is burned up fall to the ground as fine dust.

No shooting star ever has a name. A shooting star does not last long enough to have a name.

We may be very glad that shooting stars are burned up before they hit the ground. They are all very small, but even small things can do a great deal of damage when they are going as fast as shooting stars are going. Think of little bullets and the damage they can do. Thousands of shooting stars come into our air every day. Many of us might be shot by meteors if it were not for the air.

Many people have taken pictures of shooting stars. All the pictures of shooting stars look very much like the one on page 31. They show the streaks of light the shooting stars make as they fall through the air.

Sky Stones

Every once in a while a big chunk of stone or metal falls out of the sky. It gets very hot as it falls through the air, but it may not all be burned up. It may hit the earth with a fearful noise. As it falls through the air, it is called a *fireball*.

Of course, after such a chunk of stone or metal hits the earth, it cools off. After it hits the earth, it is called a *meteorite*. The meteorite in the picture on this page is the largest one ever seen to fall.

A Meteorite

Courtesy of Field Museum of Natural History



Most meteorites are made of stone, but some are made of almost pure iron. It may be that the first iron people knew about was the iron in meteorites.

Meteorites are not very common. We should be glad that they are not. A meteorite can do a great deal of damage. In Arizona there is a huge hole which was made by a group of meteorites. In northern Russia not very long ago a group of meteorites fell in a forest and knocked down all the trees for miles around. An old Chinese story tells that a meteorite once killed ten men. No one has been killed by a meteorite in modern times. Most meteorites fall into the sea.

The biggest meteorite that has ever been found was found on top of the snow in the far North. Admiral Peary, who discovered the North Pole, found it. He brought it back to this country.

How We Know

You have already been told that people began studying the sky a very long time ago. The shepherds of ancient times often stayed out of doors with their flocks at night. They watched the sky and learned to know the stars very well.

After the telescope was invented, people learned more of the secrets of the sky. They saw through their telescopes more stars than they had ever dreamed there were. They found planets that they had never seen before. They discovered new comets and moons.

They made bigger and bigger telescopes. They have now made telescopes that are so powerful that the mountains on the moon show as clearly as if the moon were less than a hundred miles away. The big telescopes are kept in buildings called *observatories*. On page 35 there is a picture of an observatory.

Cameras have helped scientists find out what they know about the sky. Often it is better to take pictures through a telescope and then study the pictures than to study the sky through the telescope itself.

The scientists who study the sky have many other instruments, too. Perhaps you will some day use some of these instruments and make some discoveries. There is still much to be found out about the sky above us.

Do You Know Now?

1. The sun is a star.
2. The sun makes life on the earth possible.
3. The earth travels around the sun.
4. The earth spins around as it travels on its path around the sun.
5. The spinning of the earth makes the sun and moon and many of the stars seem to march across the sky from east to west.
6. The moon is the earth's nearest neighbor.
7. The moon travels around the earth.
8. The moon seems to change its shape as it travels around the earth.
9. The sun has a big family of planets.
10. The planets we see in the sky look like stars.
11. Real stars are suns.
12. The stars in the sky are arranged in groups called "constellations."
13. Comets and shooting stars may sometimes be seen in the sky.
14. Sometimes sky stones, or meteorites, fall to the earth from the sky.
15. The people of olden times made up many stories to explain what they saw in the sky.

Five Puzzles

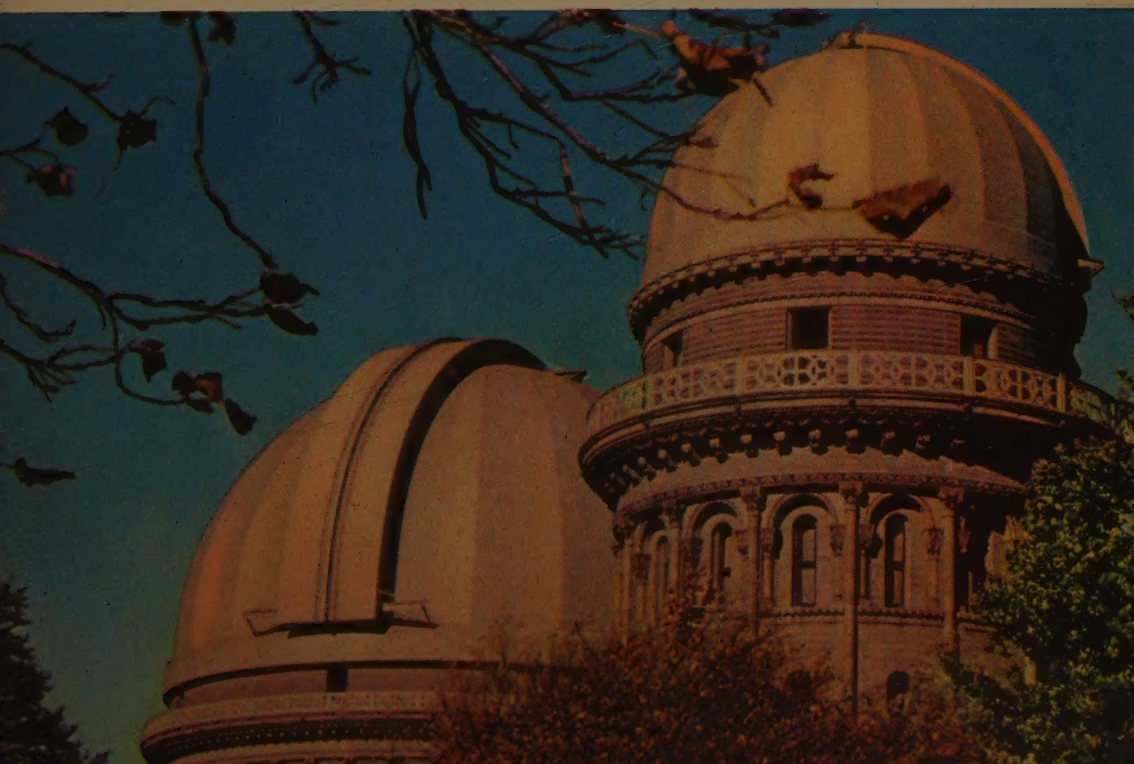
1. It is very large and very hot. It makes it possible for us to live on the earth. What is it?

2. It comes to visit us once in every seventy-five years. It has a long tail when it is close to the sun. The earth once went through its tail. What is it?

3. It has mountains on it just as the earth has. It has plains on it, too. Sometimes we can see it very well. Sometimes we cannot see it at all. Sometimes we can see it in the daytime. Sometimes we can see it at night. It seems to change its shape. What is it?

4. It is one of the sun's family of planets. It is farther from the sun than Mars, but not so far as Saturn. Sometimes it is an evening star. Sometimes it is a morning star. What is it?

5. It is a star. It is the brightest star in the sky, not counting the sun. Often it is called "The Dog Star." What is its real name?



See for Yourself

1. Look for the moon tonight as soon as it is dark. If you cannot see it tonight, look for it each night until you do see it. Then watch it night after night to see it seem to change its shape.

2. Look for the Big Dipper, the Little Dipper, and Cassiopeia tonight if the sky is clear. Find out from a star map whether Orion will be in view early tonight. If it will be, look for it.

3. Find out from a star map the names of three bright stars that can be seen early tonight if the sky is clear. Look for these three stars in the sky.

4. Find out from a newspaper or an almanac whether Venus is an evening star or a morning star now. If it is an evening star, look for it.

5. The next time the moon is full, look for the man in the moon. Look for the old man with his bundle of sticks. Look for the jumping hare. Remember that the pictures people see in the moon are made by the mountains and the plains on the moon.

6. Make a model of the moon out of clay. Make it half yellow and half gray. Hold it so that it looks like a full moon. Hold it so that it looks like a crescent moon. Hold it so that it looks like a half-moon.

7. Make small clay balls to stand for the nine planets. Use the picture on pages 28 and 29 to help you with their sizes. Do your models help you see that some of the planets in the sun's family are much larger than the earth?

8. Look at some bright star tonight. Can you see any points on it? Does it twinkle?



Y0-BYQ-093

